(80%), gas and coke are produced. Gas diesel fraction is raw material for deep cracking, so, normally, visbreaking is combined with deep cracking of heavy feedstock resulting in gas diesel fractions. Visbreaking of heavy tarry residue can also serve to reduce their viscosity and subsequent use as fuel oil.

High conversion cracking of kerosene-diesel fractions occurs in more severe conditions: at temperature of 500-510°C, pressure - 500 atm. During this process conducted with recycling of intermediate fractions, 50 per cent of cracking gasoline is produced. Currently, this type of cracking is gradually losing its relevance, as kerosene and diesel fractions of straight distillation find their direct applicability in a jet and diesel fuel.

High conversion cracking of light feedstock (thermal reforming) is carried out in more severe conditions (at temperature of 520-540°C, pressure 60-70 atm.) The raw materials are low-octane gasoline and naphtha of straight distillation. Process purpose is to obtain high-octane gasoline. At present, this type of cracking is almost not applied. Therefore, in petroleum refining the most common form of thermal cracking under pressure is residual cracking of heavy stock (residue, tar), combined with the subsequent high conversion cracking producing diesel fractions.

Coking process is to heat the heavy oil residues (tar of straight distillation, cracking residues) at atmospheric pressure and temperature of 400 – 500°C. As a result of decomposition reactions and hydrocarbon consolidation, gas, gasoline, kerosene-diesel fraction and coke are produced. The main products are coke and coking distillate.

Pyrolysis or oil pyrogenic decomposition occurs at a temperature of 680 – 750 C as well as at atmospheric pressure, i.e. in more severe conditions than coking process. Under such conditions, the petroleum feedstock is converted in more severe conditions with high gas yielding (50%) and aromatic hydrocarbon obtaining. The gas, produced during pyrolysis, is rich in unsaturated hydrocarbons, the most valuable of which is ethylene (18-28% content in gas). Pyrolysis gas is a valuable raw material for chemical processing.

Gasoline yield at single-pass cracking can be increased by deepening of cracking - accelerating of process time and temperature. During single distillate cracking, gas, 25 - 30% of gasoline, cracking residue and 50-60% of the intermediate fractions are obtained. The intermediate fraction partially consisting of unconverted materials and cracking products, may be applied for repeated cracking to obtain an additional amount of gasoline. This type of cracking, in which the intermediate fraction is continuously returned to the fresh feed mix for repeated cracking, called recycling cracking. Recycling cracking benefits are enormous. Only reforming (cracking of gasoline and naphtha fractions) is carried out without it [2].

The chemical composition of the cracking gasoline is substantially different from straight gasoline distillation of unsaturated hydrocarbons, aromatic and paraffinic isohydrocarbons. The presence of these hydrocarbons leads to higher anti-knock properties of cracking gasoline in comparison to straight distillation gasoline. Basically, straight distillation gasoline is composed of paraffins and naphthas, aromatic hydrocarbons in small amounts. The cracking gasoline contains 15-20 % of unsaturated hydrocarbons and aromatic hydrocarbons of 15-35%. The composition and properties of cracking-gasoline depend on the cracking process conditions, in which they are received. The lowest octane gasoline of visbreaking, as such cracking is mild and small amount of aromatic hydrocarbons are formed in it. High conversion cracking gasolines of distillate feedstock have an octane number of 65-70. Their composition is characterized by the presence of unsaturated, aromatic and branched paraffins. A disadvantage of the cracking gasoline is its instability during storage because of the high content of unsaturated hydrocarbons with dibond (alkadienes), proned to gum formation. Thus, thermal cracking of oil has already lost its capacities as a way of refining petroleum products, but, this method can be very useful for the refining industry, for introduction of new technologies and carrying out more detailed studies.

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ALLOWABLE AND CRITICAL RISKS OF THE ARCTIC DEVELOPMENT IN TERMS OF GLOBAL CLIMATE CHANGE

Y. Bolsunovskaya, A. Sentsov
National Research Tomsk Polytechnic University, Tomsk, Russia
National Research Tomsk State University, Tomsk, Russia

The Arctic issues are becoming increasingly important in the current studies of global climate change. This is due to the fact that the Arctic region which is characterized by complex and rather specific climatic features (ice sheet) secures the balance of global climate system. As for the Arctic region itself, it should be noted that today it presents a vivid example of transforming climatic and environmental problems into economic and political ones. The specific geographical and climatic conditions of the Arctic present a challenge to economic activity in the region. In fact, it is these conditions that restrain geophysical exploration of the Arctic continental shelf. Besides, they make higher demand on communications-infrastructure availability, sustainable development of social systems, staff resources trained specifically to work under Arctic conditions, and, most significantly, programs aimed at preserving and protecting the Arctic environment and unique eco-systems. Therefore, development of the Arctic resources is always accompanied by a great number of various risks. Such a great concentration of risks in the Arctic region is due to different factors which can be conventionally divided into natural and technogenic ones. The natural factors involve geographical location of the region and harsh weather conditions, while technogenic factors imply the impact of hydrocarbon development activities. The combination of the above factors which constantly affect the Arctic ecosystems poses an enormous threat both to the Arctic region itself and the global climate system, in general.

Arctic operations engender a variety of risks. Some risks can have a significant impact on the whole world, while others can be mitigated due to international, state and cooperative initiatives. Among the scientists and experts there is no clear agreement on the classification of risks, their adverse impact and anticipated consequences. Besides, the present approaches to classify the risks do not fully describe the nature of the risks related both to the Arctic region itself and the Arctic states. The analysis of the research literature has revealed that the classification of the investment risks related to the Arctic region development is the most debated in the international practice. However we believe that identification of climate risks with investment ones is not quite appropriate due to the fact that such a classification is aimed at evaluating impact of risks only in terms of economic activity in the Arctic region. As a result, despite an increasing number of international initiatives launched to deal with environmental issues, the consequences of global climate changes, social and environmental protection problems are regarded as issues of secondary importance. There is an enormous number of scientific publications and research literature on the Arctic climate change. But despite continuously developing modeling technologies, there is an excessive uncertainty about the climate changes, which makes it difficult to obtain reliable modeling calculations.

The basic components of the Arctic cryosphere, such as sea ice and permafrost, are among the most seriously affected by global and regional climate changes. As National Snow and Ice Data Center [6] reported, on September 11, the forth lowest Arctic sea ice extent in the satellite record for 2015 was 4.41 million square kilometers. After the date of the sea ice minimum, Arctic ice started increasing. The average Arctic ice sea extent for September 2015 was 4.63 million square kilometers, i.e. the lowest values in the satellite record. This is 1.87 million square kilometers below the 1981 to 2010 average extent; however, it is 1.01 square kilometers above the record low monthly average for September, 2012.

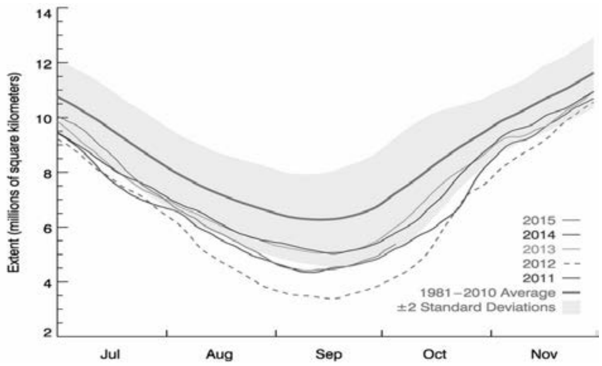

Fig. Arctic Sea Ice Extent (Area of ocean with at least 15% sea ice) [5]

The findings indicate that despite the seasonal increase (September, 2015) Arctic sea ice extent does not reach the 1981-2010 average for that month. Thus, Arctic sea ice extent changes in the cyclic manner. However, on a global scale, it continues melting. This trend is illustrated in the Figure which shows data deviation from the 1981 to 2010 for four previous years. Thawing or degradation of permafrost and associated release of carbon dioxide (CO_2) and methane (CH_4) present another significant concern. Based on Global Methane Initiative [4] data, methane emissions from oil and natural gas systems for 2010 accounted for 20% of global anthropogenic methane emissions. These emissions are projected to grow approximately by 35% by 2020. Oil and gas emissions are expected to increase the projected amount of emitted methane by 3% annually. Therefore, it can be stated that the effects of oil and gas activities in the Arctic region can be rather crucial and catastrophic. Thus, the specific natural and climatic conditions of the Arctic region pose significant limitations to the resource development perspectives in this region. It is impossible to completely eliminate natural risks which consequences are hard to predict. In addition, it is rather difficult to address these risks in the short term.

Oil and gas activity causes substantial environmental damage to the Arctic region, as a whole. The most dangerous and hard-to-eliminate consequences of such an activity are oil and chemical spills that accompany any hydrocarbon field development including drilling operations and oil and gas transportation. The most harmful effect of such accidental spills is a constant degradation of Arctic sea ecosystems. Such adverse effects of anthropogenic activities are examples of ecological risks [1]. The basic danger related to ecological risks is due to the fact that they produce combined impact on the whole region, thus, reducing efficiency of risk mitigation plans. Therefore, high environmental safety of the Arctic region is a key factor of its sustainable development.

Another challenge that impedes sustainable development of the Arctic region is significant social risks. In the Arctic region, social consequences of climate changes and anthropogenic impact are more notable due to the fact that it is place for indigenous peoples to live. Such factors as landscape continuity, maintenance of the traditional biodiversity of the Arctic region are obligatory conditions for indigenous peoples' well-being. However, the rapid warming trend and consequences of industrial activity in this region significantly reduce the possibility of on-time adaptation of local communities to ongoing changes threatening their traditional lifestyle. Besides, there is a growing risk for the health of northern peoples: increase in morbidity and mortality resulting from anomalous high/low temperatures, increased accidents of injury and mortality caused by unpredictable weather conditions (storms, floods, etc.), growing number of infectious, parasitic diseases and cancer, acute and chronic illnesses, reproductive dysfunction [3, 7].

Efficient and safe development of Arctic resources is also complicated by transport-related and technological problems. Oil and gas activity in the Arctic region inevitably involves the use of stationary drilling and production platforms, ice-class vessels designed for ice navigation, exploration, and rescue operations under harsh Arctic weather conditions. Highly-developed port infrastructure that would meet international navigating requirements is also of great importance. Due to projected increase in cargo flows on the Northern Sea Route, it is of great importance to find the ways to reduce the discussed transport-related and technological risks. Here Russia's Arctic strategies are of great value as the Northern Sea Route is the historically formed national single transport communication of the Russian Federation in the Arctic. To guarantee cargo flow security on the Northern Sea Route, it is necessary to use up-to-date engineering facilities and provide highly developed infrastructure in Russian Arctic. However, currently these conditions are not sufficiently fulfilled. In comparison with other polar countries, Russia is characterized by insufficient level of infrastructure development in the northern regions. Therefore, the problems related to the applied technologies and infrastructure should be considered in a wider arena including political background [8] and political risks [2] of the Arctic region. Today, there is no well-developed international Arctic law. The legal status of the Arctic seas is defined by the principles and norms of the international law, precisely by 1958 Geneva Conventions on the Law of the Sea and UN Convention on the Law of the Sea which do not capture many legal aspects of the Arctic issues. There is no unique approach to define the Arctic borders as a geographical region with strict division into political and administrative regions of the Arctic countries and clear mapping of areas of their responsibility.

The basic findings of the current research are as follows: relationships of the Arctic countries, as well as the Arctic region itself, are intensively transforming. Due to interacting forces of climate change, globalization, social and economic trends, there is an urgent need to modernize the already existing models of the Arctic region development. The Arctic sustainable development is directly dependent on natural, social, economic, and political uncertainties which contribute to new risks. Based on our estimates and specific geographical and climatic conditions of the Arctic, we assume that uncertainties can emerge within any activity related to the Arctic development. The analysis of ongoing transformations allows us to define four basic groups of Arctic risks which could cause negative effects on a world-wide scale: natural risks, social and environmental risks, political risks, industrial and transport risks. To predict the likely level of harm, each group of Arctic risks is divided into catastrophic, critical, and allowable.

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OFFSHORE ICE-RESISTANT FIXED PLATFORM PRIRAZLOMNAYA

D.A. Bychkov

Scientific advisor associate professor G.P. Pozdeeva

National Research Tomsk Polytechnic University, Tomsk, Russia

Prirazlomnaya is an ice-resistant oil platform, designed to develop the Prirazlomnoye field in the Pechora sea. Currently, the OIRFP Prirazlomnaya is the only platform, extracting oil production on the Russian Arctic Shelf. The first shipment of Polar oil ARCO was shipped in April 2014 and in September 2014; the millionth barrel of oil was produced on the OIRFP Prirazlomnaya.

The platform is located 55 km north of the village of Varandey in the Nenets Autonomous District and 320 km north-eastward of the town Naryan-Mar. The license for the Prirazlomnoye field belongs to LLC Gazprom Neft Shelf (a subsidiary of JSC Gazprom Neft).

The platform is designed specifically for field development and carries out all required process operations: well drilling, oil production and storage and offloading to tankers, heat and electricity generation [1]. The unique feature of Prirazlomnaya is in that, for the first time, hydrocarbon production on the Arctic Shelf is carried out from a stationary platform in the severe conditions of ice fields.